moldboard plows

- Kinds of plows
- Kinds of bottoms and shares
- Attachments for clean plowing
- Adjustments and repairs

Farmers' Bulletin No. 2172

U.S. DEPARTMENT OF AGRICULTURE

Plows are of two general types—moldboard and disk. Some sweep-type tillers are called plows by the trade, but they are more properly designated as tillers or field cultivators.

Disk plows are discussed in Farmers' Bulletin 2121, "Disk Plows." Farmers' Bulletin 1045, "Laying Out Fields for Tractor Plowing," gives suggestions that will help in using both moldboard and disk plows.

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moldboard plows

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The chief aim of plowing is to put the soil in proper condition for preparation of a good seedbed.

But in some areas plowing is also a means of—

- Controlling the European corn borer and certain other insects that find winter shelter in crop refuse left in the field.
- Controlling weeds and certain plant diseases.

The term "clean plowing" describes plowing that has these additional, crucial aims. Since clean plowing requires that all trash and cover-crop residue be covered at least 3 inches deep, it must be fitted into the farm program in a way that will keep wind and water erosion to a minimum.

To achieve maximum effectiveness in plowing with a moldboard plow, you must—

- Be familiar with the kinds of moldboard plows and select the one that is most suitable for the job that you want it to do.
- Be familiar with the kinds of plow bottoms and plowshares, and with their requirements, advantages, and disadvantages.
- Know what attachments are necessary for clean plowing.
- Know how to adjust the plow and its attachments to meet field conditions.
- Keep plow and attachments in good working order.

KINDS OF MOLDBOARD PLOWS

Moldboard plows are divided into two main groups:

One-way plows throw furrow slices in one direction only. Tractor plows throw slices to the right. Some horse-drawn plows throw slices to the right; others, to the left.

Two-way plows are equipped with right- and left-hand bottoms. They throw furrow slices to the right or to the left, the direction depending on which bottoms are being used.

One-way plows are in more common use. In the United States, the term "tractor plow" usually means a one-way plow.

In each of these two main groups, plows are classified according to hitch—the way in which the plow is coupled to the tractor unit. They may be "trailing," "mounted," or "semi-mounted." A reference to one of these types of mounting makes known two facts about a plow—(1) how the weight

of the plow is carried when the plow is lifted, and (2) how the plow is controlled when it is in the soil.

One-Way Plows

The following summary names the kinds of one-way moldboard plows and, for each kind, gives information on types of hitches and number of bottoms. Where appropriate, other characteristics are described, and statements concerning advantages and disadvantages are included.

Trailing, two-wheel

Hitch.—The hitch is semiflexible—that is, it is flexible when the plow is in the soil but its vertical movement is restricted when the plow is lifted in order to raise the rear end of the plow. This restricted movement is accomplished either by use of a short hitch link (fig. 1, *A*) or by use of a chain or rod with a long hitch link (fig. 1, *B*). Each of these arrangements limits the extent to which the front end of the plow beam can be raised without raising the rear of the plow. When the plow is lifted, the weight is carried on the two front wheels.

Some of these plows have a rigid rear wheel, or rolling landside, that takes the landslide pressure and carries some of the weight when the plow is in the soil. Others are equipped with an oversize landside, usually with a cast heel piece, to take this load.

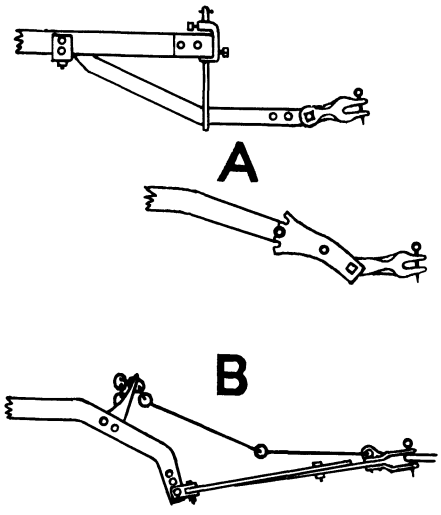

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***Figure 1.*—Hitch links for trailing, two-wheel plows: *A*, short links; *B*, long link with rod arrangement.**

Number of Bottoms.—One or two.

Other Characteristics.—These are mostly lightweight plows. Some have ample clearance between bottoms, but in others the shortening of beams—to reduce weight—has resulted in sacrifice of clearance.

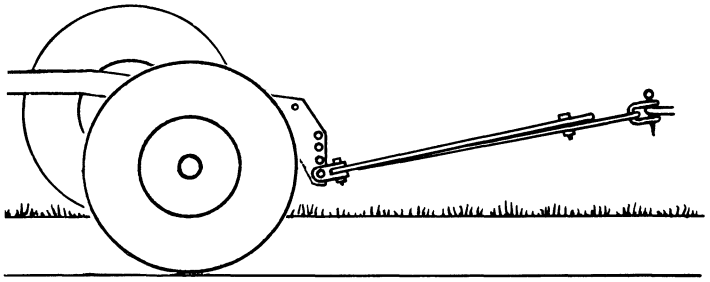

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***Figure 2.*—Full floating type of hitch used on trailing, three-wheel plows.**

Trailing, three-wheel

Hitch.—Figure 2 shows the full floating type of hitch used on this type of plow. In the lifted position the weight of the plow is on all three wheels. While the plow is in operation, the wheels may carry part of the weight plus additional operating force.

Number of Bottoms.—The number of bottoms is limited by the power available and by the prevailing land contour. Single units usually have one to six bottoms. When more than six bottoms are to be pulled by one tractor, the usual practice is to hitch two or more units together as a gang.

Other Characteristics. — These plows are self-contained units. They are usually built for heavy duty. They may be lifted, lowered, or leveled mechanically or hydraulically. They have more clearance under beams and between bottoms than most other types.

Mounted

Hitch.—These plows are coupled rigidly to the hitch points provided on the tractor. The tractor drive wheels serve to steady the plow and assist in regulating depth. Adjustments for leveling and controlling the plow are provided in the tractor hitch mechanism. (See fig. 3.)

When the plow is lifted, the entire weight is carried by the tractor. Some of these plows have a rigidly mounted rear wheel, or rolling landside; when the plow is in the soil, this wheel receives the landside pressure and carries some of the weight of the plow.

Number of Bottoms.—One to eight.

Depth Controls.—Four types of depth controls are used in mounted plows: Draft-control system, ball-and-socket system, converging linkage system, and gage-wheel control.

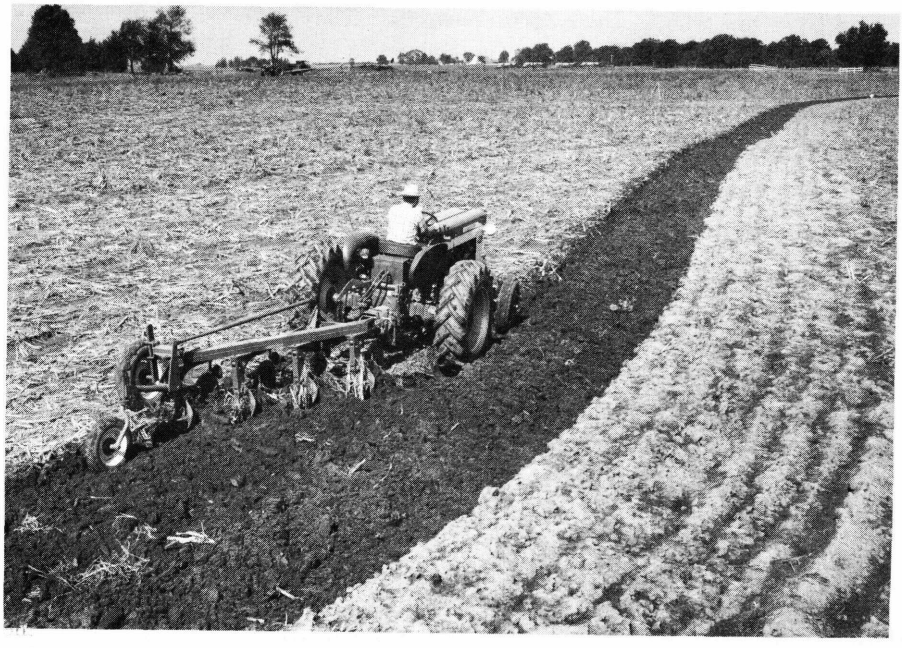

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***Figure 3.*—A mounted-type plow in a contoured field.**

Adjustments vary according to make and design. The instruction book furnished with each make explains adjustments fully.

Advantages.—Advantages are ease of operation, low cost, maneuverability in transport, and addition of weight to rear wheels of tractor (due to downward force on front of plow frame).

Disadvantages. — Disadvantages are limited flexibility for plowing on the contour and plowing rolling land, reduction in clearance between and under beams on some plows (to make plow more compact), and the fact that the plow can be used only on tractors having the correct type of hitch mounting.

Semimounted

Hitch.—These plows have novel hitch mechanisms. (See "Advantages.")

The rear part of the plow is supported by a tail wheel, which is permitted to caster. When the plow is raised, about 30 percent of the weight is on this wheel. When the plow is in the soil, the wheel may lock in position and help stabilize the plow. However, on some plows it does not take side force at any time.

Number of Bottoms.—Three or more.

Advantages.—Versatile hitch mechanisms permit freer lateral movement between plow and tractor than do the hitches for mounted plows; they also permit vertical flexibility when going over terraces and other rough terrain. Short coupling provides excellent maneuverability. As pull increases, weight on rear axle of tractor increases; this increases traction and helps reduce slippage.

In addition, these plows have ample room for attachments, ample clearance for trash, and enough weight for good penetration and stability.

Two-Way Plows

Two-way plows are for use on hillsides, on terraced fields, and wherever dead furrows must be avoided—for example, in irrigated fields. The use of right- and left-hand bottoms makes it possible to turn all furrow slices uphill when plowing on the contour, to turn all furrows one way in a field that should have no dead or back furrows, or to throw slices to the right or to the left (as may be desired) when building or maintaining terraces.

These plows are in two main groups—trailing and mounted.

Trailing

These units have the characteristics and advantages of the two-wheel one-way plows. They are self-contained units. They differ from the one-way plows in that they have right- and left-hand bottoms, which are mounted on separate frames having common transport wheels and hitch arrangement. Lifts are provided for each set of bottoms, and the hitch arrangement automatically shifts to the correct position for the bottoms lowered into operating position.

Mounted

Mounted units are of two types—rollover and pivot.

In a unit of the rollover type (fig. 4), the beams, bottoms, and attachments are mounted on a frame that rotates on a longitudinal pivot. The frame is turned by a double-acting cylinder or by a mechanical arrangement. When the frame turns, it places in position the left-turning bottoms or the right-turning bottoms, as desired. A latching mecha-

nism secures the bottoms in operating position. Clearance between bottoms and underbeams usually is sufficient to accommodate attachments and to permit trash to pass through. Most of these plows cut two or more furrows.

Plows of the pivot type (fig. 5) are usually lighter in construction than those of the rollover type. The right-turning and left-turning bottoms are set with their landsides at an angle to each other; the angle is 90° or less. The bottoms are shifted from right-turning to left-turning position, or vice versa, when the plow is raised. With some plows, the shift to the correct turning position is made manually while the bottoms are raised for turning at the headlands. With other plows, the shift is made automatically by the action that raises the plow.

Although this bulletin is concerned primarily with tractor-drawn plows, most of the principles discussed are applicable to horse-drawn plows. The only section *not* applicable to any horse-drawn plow is "Kinds of Moldboard Plows," page 3.

Under "Hitch," page 18, the discussion of depth and width of cut applies to horse-drawn plows, but the discussion of side draft does not. With a horse-drawn plow, side draft can be reduced or eliminated only by hitching the horses tandem instead of abreast.

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***Figure 4.*—Rollover-type two-way plow. One set of bottoms is upside down while the other is in operation. Hydraulic cylinders are used to rotate the bottoms.**

PLOW BOTTOMS

A plow bottom is a three-sided wedge. One side is the plane of the cutting edge of the share, one side is the landside, and the third side is the curved face of the moldboard.

As this wedge is pushed forward in the soil, blocks of soil are broken off at an angle of approximately 90° to the cutting edge of the share. The cutting edge of the share cuts the bottom of the furrow slices and moves under the soil blocks broken loose by the wedge action.

As the ends of these soil blocks are raised to pass up the moldboard, the blocks break down to conform to the curved shape of the moldboard. This action and the rubbing of the soil

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***Figure 5.*—Pivot-type two-way plow. To get the correct bottom into operating position, the operator pivots the plow while it is raised. On some plows the pivoting is done by the lift mechanism.**

blocks against each other pulverize the turning furrow slice.

The landside is pressed against the furrow wall by the total side pressure on the bottom. This is made up of the side pressures due to the angle of cut of the share, the side pressure required to break out the soil blocks, and that required to move the furrow slice to one side.

Kinds

Many kinds of plow bottoms are available. They have been designed for different soils and soil conditions and for different kinds of work. Two special-purpose bottoms represent extremes in design:

- The breaker bottom is for turning stiff sod or very heavy soils. The moldboard is long and low, and has a gradual turn. It tends to invert the furrow slice with little pulverization.
- The stubble-type bottom has a short, rather high moldboard; the turn is abrupt. This moldboard inverts the furrow slice quickly and tends to pulverize it.

Between these two extremes are a great variety of general-purpose bottoms developed to meet variations in plowing conditions.

Requirements

Good plowing requires a bottom that turns well-laid furrow slices. For this reason, bottoms that resemble the breaker type are desirable for plowing stiff soils and tame sods, and bottoms that resemble the stubble type are desirable in light sandy soils. If a bottom resembling the stubble type is used in stiff soils and tame sods, the furrow slice does not follow the abrupt turn of the moldboard; instead, it buckles on the moldboard and is thrown out in pieces. If a bottom resembling the breaker type is used in light sandy soils, the furrow slice crumbles and falls before it is completely inverted.

Large bottoms cover surface debris—whether ordinary trash, stalks, or green manure crops—better than small ones. They do so because of the larger open furrow, increased clearance between beams, and increased volume of soil handled. In some areas where clean plowing is an important aim of plowing, there is a tendency to use plows having 16-inch or wider bottoms, often referred to as "big-base" plows.

Farmers who are thinking of plowing with big-base plows should consider whether it will leave their soil in good condition for making the desired seedbed. Large bottoms do not turn hard, dry soils or heavy clay soils as smoothly as do small ones. This may not be objectionable if the land is to be plowed

SPEED OF PLOWING

Speed of plowing is an important factor in good plowing.

Plow bottoms do their best work when operated within a relatively narrow speed range. The ranges are approximately 1½ to 2½ miles per hour for horse-drawn plows, 3 to 4½ miles per hour for most tractor plows, and 5 to 6 miles per hour for so-called high-speed bottoms.

When plowing speed is reduced below these speeds, furrows are not turned smoothly, the open furrow is narrow, and coverage and pulverization are poor.

High speeds waste power, throw the soil too far, and usually result in very poor coverage. High speeds may also result in damage to equipment and injury to the operator; this danger is greatest when plowing in new or stony ground, where the plow is likely to strike solid objects.

in the fall for spring seeding. Most big-base plows leave mellow soils in good condition to be worked into seedbeds.

Other requirements are that the bottom must scour, resist wear, and have relatively low draft.

Usually, a type of bottom that is in common use in a locality meets most of these requirements. If you are interested in buying a plow bottom of a type that has not proved its worth in your locality, it is advisable to test it before buying it; try it out on your farm.

Where soil conditions on a farm differ widely, or where different crops are to be plowed under—for example, cornstalks in one field and heavy sod in another—it may pay to have two sets of bottoms for the plow. Most manufacturers furnish—through their dealers—several types of bottoms that can be interchanged by removing and replacing a few bolts.

Plowshares

Plowshares are of two main types—conventional and simplified. The cost of conventional shares makes it uneconomical to replace them as they become dull, and it is customary to sharpen them periodically by forging. Simplified shares, a more recently developed type, may be sharpened by grinding or may be replaced.

A share is made of one of these materials:

- Chilled cast iron.
- Cast steel.
- Solid steel.
- Soft-center steel.

Chilled cast-iron shares are used largely in sandy or gravely soils. Compared with steel shares, they are harder, break more easily, and are cheaper. They are hardest on the underside and therefore resist wear best where the wear is greatest.

Cast-steel shares are the least expensive of the steel shares. They are fairly hard and can be used in any soil in which they will scour.

Solid steel and soft-center steel shares scour in soils in which other shares stick. The surface of soft-center shares is harder than that of any other share and is therefore most resistant to wear and scours best; yet, owing to the soft core, these shares do not break easily.

Conventional shares

Conventional shares have points that are shaped about as shown in figure 6. This shape, which was developed through years of field experience, penetrates ordinary soil efficiently and stands rough use.

The clearance shown in figure 7, usually referred to as "down suck," varies with different makes and types of plows. Similar clearance at the side is called "land suck." Manufacturers' instruction books give measurements of such for their plow bottoms.

Deep-suck shares may be obtained for plowing hard, dry ground. The points of these shares turn down a little more than the points of regular shares. Points that turn down too much may make the plow gouge and run unevenly.

The relation of a share to the other parts of a plow bottom is illustrated in figure 6. When a new bottom of this type is placed on a flat surface, the weight rests on the cutting edge at the point of the share, on the small bearing area at the wing of the share, and on the heel of the landside. (These areas are shaded in the figure.) When the plow is at work in hard ground, most of the downward pressure is carried on the underside of the point; the wing bearing and the heel of the landside assist in holding the plow bottom level. All other parts back of the cutting edge must clear the bottom of the

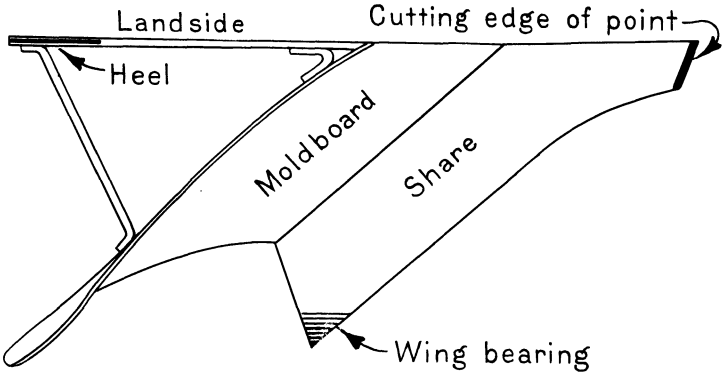

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***Figure 6.*—Top view of walking-plow bottom equipped with a conventional share. Heavily shaded parts on underside of plow carry the weight when the share is new.**

furrow so that the plow will enter the ground freely and hold its depth. A tractor plow share has no bearing area under the wing of the share. The vertical load is carried on the wheels of the plow or on the tractor.

Simplified shares

The high first cost of conventional shares and the lack of blacksmiths to sharpen them prompted the development of bottoms that use simplified, low-cost shares. These shares may be sharpened by grinding, but this is seldom done—shares or points, or both, are simply replaced when worn.

Some simplified shares are made in one piece and others in two pieces (fig. 8). The two-piece construction makes it possible to replace the point and cutting-edge sections independently.

Because of the economy in share upkeep, bottoms with simplified shares should be given careful consideration when plowing equipment is purchased.

Special shares

"Cobblestone" shares may be used on all but walking plows. They are designed for stony land and for dry, hard ground. The narrow wings cut

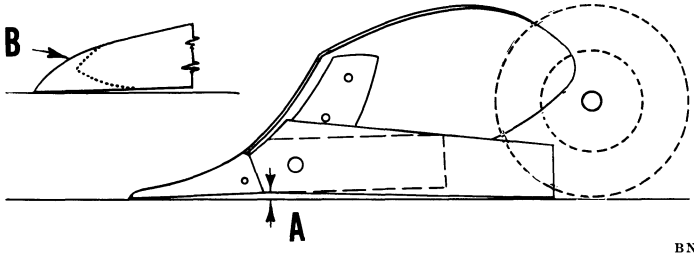

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***Figure 7.*—Side view of plow bottom fitted with a full-length landside. Broken lines show how a short landside would be set if rear wheel were used. • Clearance (*A*) is usually termed "down suck." • *B*, View of a good point. Dotted lines show how it may look after hard wear.**

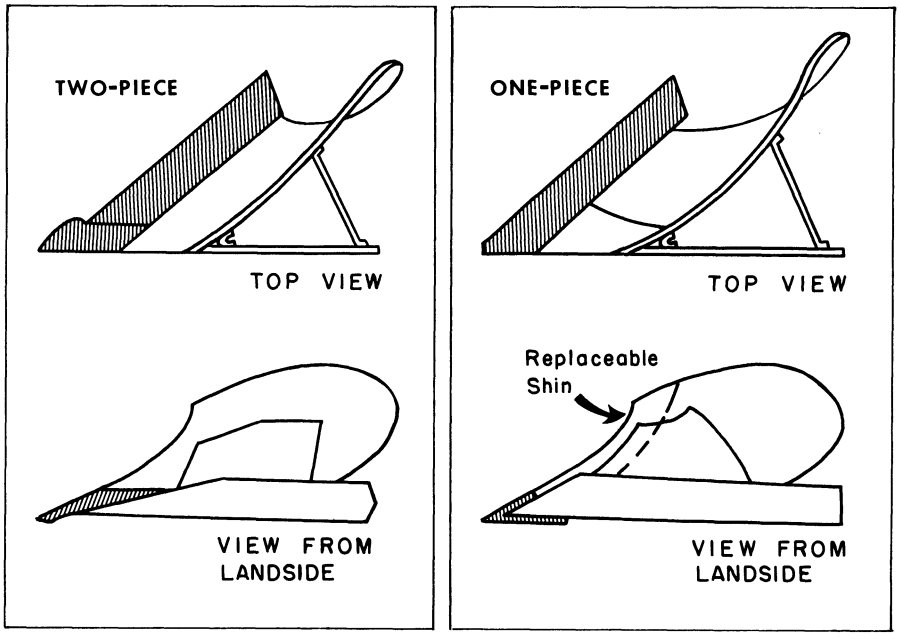

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***Figure 8.*—Plow bottoms with simplified shares (shaded areas). • Left: Bottom having a two-piece share and point arrangement. • Right: Bottom having a share made of a single piece of steel cut to shape and bolted in place. • A replaceable shin, shown in lower view at right, is essential with either of these types of shares.**

less than the full width of the furrow, but the bottom turns a furrow of the same width that would be turned if a standard share were used.

"Alfalfa" shares are available for alfalfa sod and other extremely large-rooted crops. They are wider and flatter at the wing than standard shares, and the cutting edge is at a blunter angle to the landside. The shape and setting reduce the tendency of a plow to slide around large roots.

"Notch-edged" shares are also available for alfalfa sod.

Long and short shares are available for bottoms using simplified shares.

ATTACHMENTS FOR CLEAN PLOWING

A plow without attachments may turn over clean stubble land satisfactorily, but attachments are needed to do a clean plowing job on—

- Sod land or weedy land.
- Land on which a heavy cover crop is growing.
- Land covered with straw, cornstalks, or manure.

The main attachments are colters, jointers, covering wires, and moldboard extensions. The first three are suitable for plowing under cornstalks or a heavy cover crop, such as sweetclover. The purpose of moldboard extensions is to extend the action of the moldboard and help turn the furrow slice more completely.

Since colters, jointers, and covering wires need space in which to do their work, plows equipped with any of these attachments should have ample clearance under the beams, braces, and axles. A multibottom plow must have enough space between the moldboard of each bottom and the upright part of the beam ahead to allow the furrow slice and trash to pass without clogging. The more clearance at this point the better.

Colters

Types of colters in general use are rolling, fin, and deflecting. Several other types are made for special conditions.

Rolling colter

A rolling colter is a flat disk blade (fig. 9). It may be 10 to 18 inches in diameter (for use on most plows) or up to 30 inches (for special plows). It cuts roots and surface trash that, if not cut, would cause ragged furrow walls or clog the plow. A clean, open furrow with an even furrow wall makes driving easier, gives a well-defined area for burying trash, and helps to insure cutting the correct width with all bottoms.

In general, rolling colters improve the work, but they are not always satisfactory in soil that contains loose stones.

Large colters do better work and wear longer than small ones. In sod,

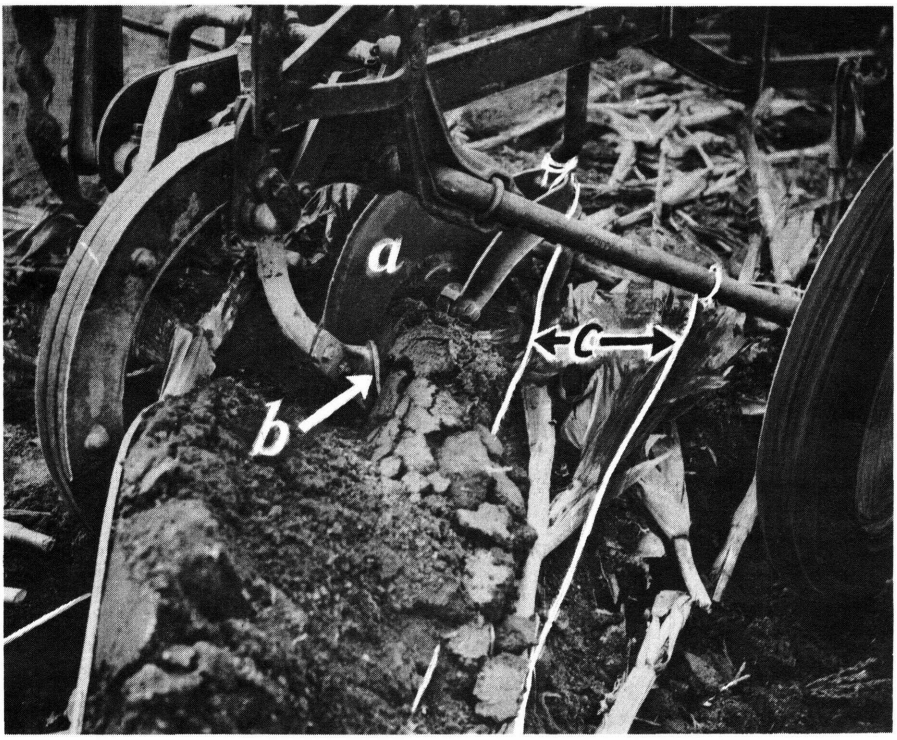

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***Figure 9.*—Attachments help bury trash. Rolling colter (*a*) cuts pieces; jointer (*b*) moves roll of soil and trash toward open furrow; covering wires (*c*) guide trash under turning furrow slice.**

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PRACTICES THAT AID CLEAN PLOWING

The effectiveness of clean plowing is increased if certain practices are followed in carrying on other farming operations.

- Row crops should not be ridged by cultivation more than is necessary to control weeds. Root clumps from drilled crops are usually easier to handle than those from hills for checkrowed crops.
- Pasturing a field reduces the crop residue to be plowed under, but stock should be kept out of the field when the soil condition is such that the soil would be packed.
- Disking with a sharp disk when the soil is relatively dry reduces ridging and cuts up stalks. Breaking down stalks with a drag or heavy pole may help. A disk or drag should travel in the direction of plowing, so that, in relation to the plow, stalks will be leaning forward.
- A mechanical cornpicker usually leaves stalks in good condition for turning under cleanly. If trouble arises, it is usually because stalks have been pulled loose or because the direction of plowing is different from the direction in which the picker traveled.
- It is advisable to remove cornstalks or other heavy debris from headlands and back furrows. Debris can be covered in back furrows, but operations required to complete seedbed preparation and to cultivate the crop may bring debris to the surface.
- Disk harrows, spring-tooth drags, and similar tools must be used with care to prevent bringing buried material to the surface.
- Plows operating in heavy soils often turn over large clods or lumps with spaces between them. Pulling a spike-tooth harrow, plank drag, or some type of roller in the direction of plowing helps to break up the clods and fill the holes, thus giving better coverage of the trash and reducing the amount that may be brought up by later operations.

12- or 13-inch colters are satisfactory; but in heavy, coarse, or loose trash they are ineffective. If the plow has sufficient clearance, colters at least 15 inches in diameter should be used. In heavy trash, 17- or 18-inch colters are best and should be used if the plow has sufficient clearance to accommodate them. They mount and cut trash that smaller units may push ahead until clogging occurs.

Rolling colters of a special type ("moon type") are available for plows with clearance too low to permit the use of large colters. They have a curved trash guide on the front and a small-diameter bearing mounting. Excellent performance can be obtained in rather adverse conditions from moon-type colters as small as 10 inches in diameter. They are often used on horse-drawn plows.

Fin colter

A fin colter is a flat blade riveted in upright position to the side of the share just behind the point. It cuts roots satisfactorily but is less effective than a rolling colter for handling trash. It

needs little attention other than occasional sharpening.

Since a fin colter is lighter than a rolling colter, and does not tend to lift the front of the plow, it may be preferred on walking plows.

Deflecting colter

A deflecting colter is a combination of a fin colter and a jointer. It is satisfactory for breaking new ground.

Jointers

A jointer, or skimmer, may be thought of as a miniature plow mounted ahead of the plow bottom. It may be of the moldboard type, which resembles a small plow bottom, or of the disk type.

The jointer cuts a shallow furrow, 3 to 5 inches wide, ahead of the furrow cut by the plow bottom. It turns this shallow furrow, and the trash or soil-building crop on it, toward the open furrow. As the moldboard turns the plow furrow on edge, much of the trash or top growth moved by the jointer rolls to the bottom of the furrow and is covered by clean soil.

A jointer is an aid to clean plowing; it reduces the amount of trash that protrudes from the seams between furrows. In addition, a jointer enables farmers using small plows to handle soil-building crops efficiently.

Moldboard jointer

A moldboard jointer mounted on a shank connected directly to the beam of the plow is called an independent jointer. It may be used alone or in conjunction with a rolling colter.

Jointers are usually used with rolling colters. They may also be mounted on shanks clamped to the yoke of the colter mounting (fig. 10). This arrangement is called a combination colter-jointer unit. Under ordinary soil conditions, either arrangement is an aid to clean plowing, provided the plow has enough clear-

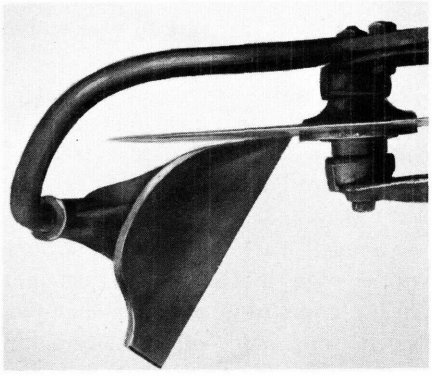

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***Figure 10.*—Top view of combination colter-jointer unit, showing proper setting of jointer point against colter blade.**

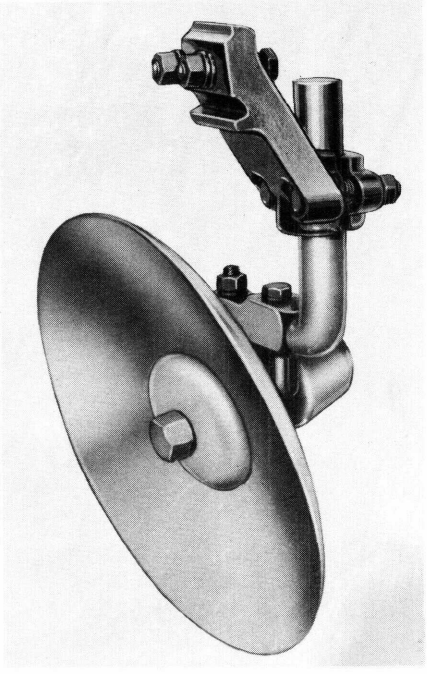

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***Figure 11.*—Disk jointer.**

ance to allow the trash to pass without clogging.

An independently mounted jointer is more rigid than one mounted on the colter shank, and therefore is preferable in hard and stony soils.

With an independent jointer attached to a small tractor plow or to a horse-drawn plow, it is possible to turn under heavy crops of Austrian Winter peas, vetch, rye, and other soil-building crops. The jointer parts the growing crop as effectively as a colter, and it moves the top growth toward the open furrow.

Disk jointer

A disk jointer consists of a concave disk, or blade; a standard; and a clamp (fig. 11). The clamp locks the blade in position at an angle to the direction of travel.

A disk jointer may be substituted for a moldboard jointer, for a combination colter-jointer, or for a colter. It turns a ribbon of soil that is usually narrower than that turned by a moldboard jointer. This often is a disadvantage. An advantage is that under some conditions a disk jointer scours better than a moldboard jointer. It must be adjusted carefully, as explained on page 25.

Covering Wires

Covering wires are pieces of smooth No. 8 or No. 9 soft iron wire 10 to 15 feet long. They help to hold trash down and to direct it under the turning furrow slices (fig. 9).

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***Figure 12.*—Moldboard extensions.**

Moldboard Extensions

Moldboard extensions, which are shaped to continue the curvature of the moldboard, give the turning furrow slice the slight additional push often needed to lay it over smoothly and to cover trash more effectively (fig. 12). They are furnished with, or are available for, many tractor plow bottoms.

Coverboards

A coverboard is a curved piece of hard, highly polished steel mounted above the moldboard. It moves some soil and a strip of surface cover toward the open furrow so that it can be covered by the turning furrow slice. Coverboards may be used in place of jointers.

Other Attachments

Weedhooks are useful for covering crop residue or cover crops attached to the ground, but are not effective in loose trash or manure. They can be used on two-way plows. Wires would become tangled on this type of plow.

Shields for deflecting trash to the bottom of the furrow are available for some plows from the manufacturers. They can be very effective.

Flat springs, shaped like sled runners and known as broomcorn springs, are sometimes used to cause loose or bushy trash to feed under rolling colters.

GETTING READY FOR PLOWING SEASON

Before the plowing season, check the condition of your plow and make any repairs that may be needed. By doing so you will avoid delays in the field when plowing conditions are most favorable.

Worn Points

When a share point wears to the extent shown by the dotted line in figure 7, *B*, it will not enter hard ground properly. A worn point on a simplified share should be replaced.

If the point on a conventional share is worn, the share should be replaced or reshaped. The choice between replacing or reshaping depends on the kind of material from which the share is made and the extent to which the share is worn.

Chilled cast iron

Shares made of chilled cast iron may be sharpened by grinding off the top of the cutting edge, but they cannot be changed by forging. Since these shares are cheap, it is better to put on a new share than to attempt to repair one that is badly worn. Be sure that the new share is designed for the bottom; a cast share that does not fit properly will break easily.

Steel

Worn points and cutting edges on cast steel, solid steel, and soft-center steel shares should be reshaped by forging, unless the share is worn too badly. Often a reshaped share does not resist wear as well as a new one, but careful heat treating or extra working should make it wear almost as well.

The following instructions for sharpening steel shares are furnished by a plow-manufacturing company:

> Build a fire on the forge suitable for this particular work. This is done by banking the fire, allowing only a small opening in the side for the blaze and heat to escape. Commence with the point of the share. Insert this into the fire just far enough to heat the part you wish to draw, never permitting the

heat to extend farther back on the share than is absolutely necessary. Draw this down to the proper shape and thickness, which should be as near the original bevel as possible. After the point has been finished, work back toward the heel or wing of the share, never heating more than 1½ inches from the edge and 2½ inches wide. It is important to keep hammering after the steel has changed from a red heat to a black, as this makes the edge tough and hard, giving a wearing surface that will last much longer.

If once down the share is not sufficient, reheat; but confine the heated part to the above measurements. In working along the cutting edge, keep it straight. In so doing you will avoid having to go back and reset the edge.

After the whole share has been reshaped, the point may be reheated and chilled to give it additional hardness and wearing quality. Heat about 3 inches of the point to a dull cherry red, then quench in water until cool. This treatment is not recommended for the whole share, because of the difficulty of getting an even heat and the danger of warping.

If the plow is to be used in soil in which it may strike large stones, it is best not to chill the point. Instead, increase the hardness and toughness of the point by hammering it until it is cool.

A thin layer of a very hard alloy metal may be welded onto the point and cutting edge with an acetylene torch or electric arc to increase resistance to wear. This should be done either on a new share or before the share is badly worn, so that it will have the shape of a new share. This does not materially reduce breakage.

Wing Bearing

Too little flatness at the wing bearing causes a walking plow to lean toward the open furrow, or "wing down." Too much causes it to "wing up." One rule is that the wing bearing for a 14-inch walking plow should be 1¼ inches wide, measured toward the landside from the corner of the share.

The wing bearing of a steel share may be changed in the field by bending it carefully with an adjustable wrench.

Wing bearing is not needed in most wheeled plows, because the wheels steady the plow in the crosswise direction.

The proper wing bearing and down suck of walking plows depend chiefly on the conditions under which the plow is to be used. For instance, some land, if being plowed in the spring, may require a large amount of wing bearing and very little down suck. But if the same soil is dry, it may be desirable to reduce wing bearing (perhaps to the point of almost removing it) and to increase down suck to three-eighths of an inch or more.

Blacksmiths usually adjust wing bearing and suck according to local soil conditions and the season in which the plow is to be used.

FIELD ADJUSTMENTS AND REPAIRS

Field adjustments are necessary to compensate for wear on the share and other parts of the plow, to permit the plow to do its best work in soils on different parts of the farm, and to accommodate the plow to changes in soil moisture.

The suggestions that follow deal with these adjustments, with the setting of attachments, and with the care of plow and attachments.

Hitch

The hitch should be set so that the plow runs level at the desired depth and width of cut without much guid-

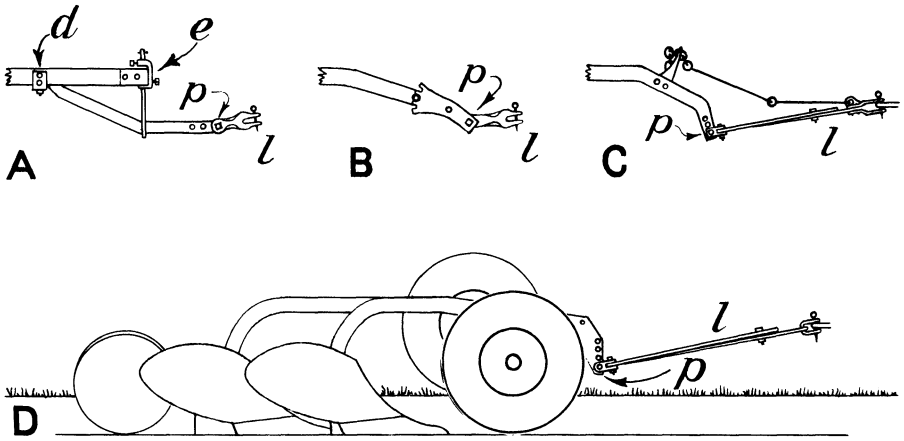

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***Figure 13.*—Four hitches commonly used on trailing-type tractor plows.**

ance from the wheels or tractor mountings or—if it is a walking plow—from the handles. Improper setting is likely to result in excessive wear on shares, wasted power, and poor work.

Depth of cut

Trailing Plows.—Four common types of hitches used on trailing-type tractor plows are shown in figure 13. All are set according to the same principle. Raising the pivot bolt *p* at the rear of the floating link *l* or lowering the hitch point on the tractor makes the plow tend to run deeper; lowering *p* or raising the hitch on the tractor makes the plow tend to run shallower. It is best to keep the hitch point *p* as low as possible and have the plow operate at the desired depth. It may be necessary to raise hitch point *p* if the tractor hitch point is as low as possible and the plow is not cutting to the desired depth. Major depth adjustments should be made with the hitch. Lever adjustments should be made only to accommodate the plow to soil differences in the field and to hold the plow level.

If the plow runs unevenly and fails to hold the depth for which the wheels are set, check the condition of the shares; replace or recondition them if they are worn badly. If the shares appear to be in satisfactory condition, lower the hitch on the tractor drawbar if possible. If the plow still fails to penetrate, raise the hitch slightly on the plow beam (fig. 13).

If lack of penetration is due to dull or improperly shaped shares, dull or improperly adjusted colters, or extremely hard soil, raising the hitch too high on the front of the plow in an effort to get penetration will result in "nosing" (fig. 14, *A*). The operator cannot control the hardness of the soil, but he can improve plow operation by using sharp, correctly shaped shares and sharp, correctly adjusted colters (fig. 14, *B*). (See discussion of setting colters for hard ground, p. 23.)

If the plow tends to run too deeply, has much heavier load on the front wheels than on the rear wheel, or land side, and the levers are hard to shift while the plow is in operation (because of a relatively large downward load), the hitch should be lowered on the front

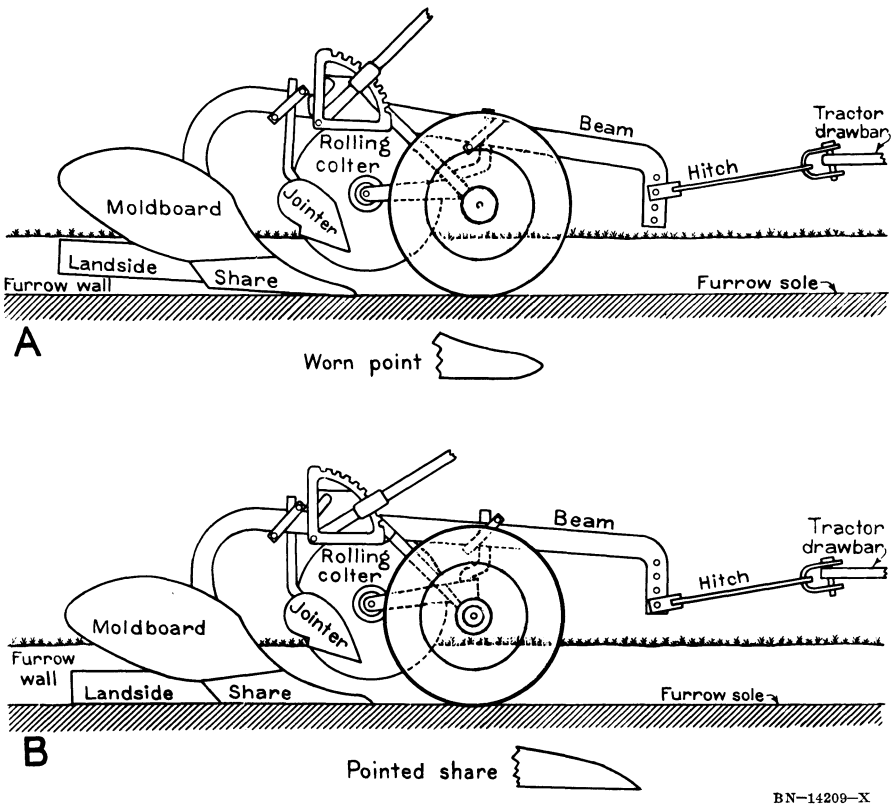

***Figure 14.*—Good shares and proper hitch adjustment are necessary for good work. • *A*, Share with worn point fails to penetrate ground properly. Hitching high on beams to force plow deeper throws it "on its nose," with landside riding up. • *B*, A correctly pointed share draws the plow into the ground. The hitch should be set low enough at beams to hold the plow level and in balance at the depth desired.**

of the plow until the condition is corrected. If hitching in the lowest position (fig. 13, *C*) is not enough, raise the hitch point on the tractor drawbar. Note, however, that raising the hitch point too high on the tractor may make it difficult to steer.

Mounted and Semimounted Plows.—The methods of adjusting mounted and semimounted plows for depth vary with the type and make of plow. The principles explained above are applicable, but the adjustments are not so obvious. The manufacturer's instruction book should be followed in making adjustments.

Width of cut

Trailing Plows.—The horizontal adjustment of the plowhitch should be set to cause the bottom on a single-bottom plow or the front bottom on a multibottom plow to cut its rated width. After the hitch point on the tractor has been selected to balance the side draft between the tractor and the plow (see p. 21), regulate width of

cut by adjusting the plow hitch—not by shifting the tractor drawbar or the point of hitch on the drawbar.

V-type hitch (figs. 15 and 16).—Lengthen or shorten one side of the V.

Offset clevis (fig. 13, B).—Four width settings are possible. Set the clevis to the right or left on the end of the beam, or turn it upside down.

Pivoted hitch bar (fig. 13, A).—The entire hitch bar including link *l* pivots on the rear attachment point *d*. It is held from pivoting by clamp *e* on the cross member at the front end of the beam. Loosening clamp *e* and moving the hitch clevis toward the open furrow increases the width of cut—moving it toward the unplowed land decreases the width of cut.

Mounted and Semimounted Plows.—The width of cut for the bottom or the front bottom of a multibottom plow is usually controlled by the spacing or location of the rear tractor wheels on the axle. Manufacturers' instruction books give the settings or location for the rear wheels of the tractors on which the particular plow can be used.

Side draft

Side draft is caused by the fact that the line of draft of the plow and the line of pull of the tractor do not fall on the same line. The line of pull for a tractor is in the direction of travel and is located halfway between the drive wheels. It passes through the center point in the hitch if the drive wheels are set equal distances from the center line of the tractor.

For hitching purposes, the line of draft of a plow bottom can be considered as being about one-sixth of the width of cut from the landside and five-sixths from the open furrow. For a multibottom plow, the line of draft is one-half the width of cut for the plow, minus one-third the width of cut of one bottom from the line of the shin of the rear bottom. Example for a plow having four 16-inch bottoms:

$4 \times 16 = 64$ (width of cut of plow).
$64 \div 2 = 32$ (one-half the width of cut).
$16 \div 3 = 5\frac{1}{3}$ (one-third the width of cut of a bottom).
$32 - 5\frac{1}{3} = 26\frac{2}{3}$ (distance from the line of the shin of the rear bottom to the line of draft for the plow).

Trailing Plows.—Two situations are considered:

1. Line of draft is almost directly behind the center of the tractor, as it is when a two- or three-bottom 16-inch plow is drawn by a conventional-width four-wheel tractor (fig. 15).

2. Line of draft is decidedly off center with reference to the tractor, as it is when plows are drawn by wide-tread tractors of the general-purpose type (fig. 16).

The problem of side draft is more likely to arise, and is more difficult to handle, in situation 2. If the ground is hard, the problem is increased.

In both situations, if you hitch the clevis on the drawbar near the line of draft (line *B*), to relieve the plow of side draft, you may cause the tractor to pull sidewise; and if you hitch it in the middle hole of the drawbar to relieve the tractor of side draft, you may cause the plow to be pulled cornerwise.

As indicated in the drawings, the proper procedure is to divide the side draft between the plow and the tractor.

Adjustment for situation 1 (fig. 15): Hitch the clevis between *A* (middle hole of the drawbar) and line *B* (line of draft).

Adjustment for situation 2 (fig. 16): On some general-purpose tractors provision is made for setting the drive wheels closer together or farther apart. If this adjustment can be made on your tractor, and if much plowing is to be done, side draft can be reduced by

setting the drive wheels as close together as possible; this brings the center of the tractor as close as possible to the line of draft of the bottoms.

When using a one-way plow it may be necessary to move only the furrow wheels toward the center of the tractor.

If narrowing the tractor tread is impossible, or might cause the tractor to tip over, follow this procedure:

- Hitch the clevis between *A* (center of the drawbar) and line *B* (line of draft); then make an adjustment for width of cut.
- If the plow tends to pull cornerwise, shift the clevis nearer to the line of draft, thereby putting more of the side draft on the tractor; then readjust for width of cut.
- If the front or rear wheels of the tractor are pulled sidewise to an objectionable degree, shift the clevis nearer to the center of the drawbar, thereby putting more of the side draft on the plow; then readjust for width of cut.
- If the difficulty cannot be overcome by these adjustments, it may be necessary to lengthen the plow hitch.

Mounted and Semimounted Plows.—Instruction booklets furnished by the manufacturers of mounted and semimounted plows contain instructions on spacing of wheels, mounting the plows, and making adjustments to reduce the effects of side draft. Follow these instructions. For each type and size of plow, the manufacturer has worked out the most effective mountings and adjustments.

Hitch releases

Hitch releases, or overload releases, are safety devices. They provide protection when a plow bottom strikes an obstacle, such as a stone or root, that does not yield readily. Without such protection, the impact may damage the plow and may result in injury to the operator.

Break Pins.—A break pin in the hitch is fairly satisfactory for one- or two-bottom plows that are to work where obstructions are few. Tighten the bolts in the slotted holes of the breakaway part of the hitch just enough to prevent excessive wear on the pin.

Spring-Controlled Releases.—Some trailing and mounted plows are equipped with spring-controlled hitch releases. One type snaps back to working position automatically after functioning; the plow may be recoupled from the tractor seat. Another type must be reset by the operator.

Releases Mounted in Beams.—Many multibottom plows are too large and operate at speeds too high for a single release to provide satisfactory protection.

Individual releases—one for each bottom—have been developed for such plows. They are mounted in the beams. Only the bottom that strikes an obstacle is released.

These releases may be trip springs or break-pin arrangements (fig. 17). Returning a released bottom to operating position is easier with the trip-spring units. The bottom can be reset by backing the plow while it is still in the lowered position. Where break pins are used, it is necessary to raise the plow, return the bottom to operating position by hand, and replace the pin. The break-pin arrangement is considered satisfactory for plows that are to work where obstructions are few.

●

Use a hitch release at all times when plowing. Keep it in good working order.

A break pin must be made of the material recommended by the manufac-

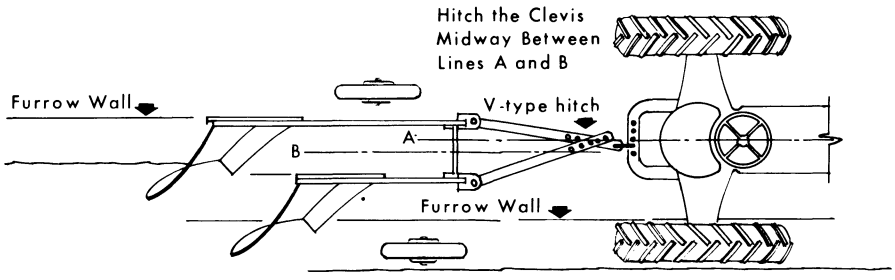

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***Figure 15.*—There is little side draft when a two- or three-bottom plow is drawn by a standard-width tractor. For best results, the hitch point on the tractor should be midway between lines *A* and *B*, as shown.**

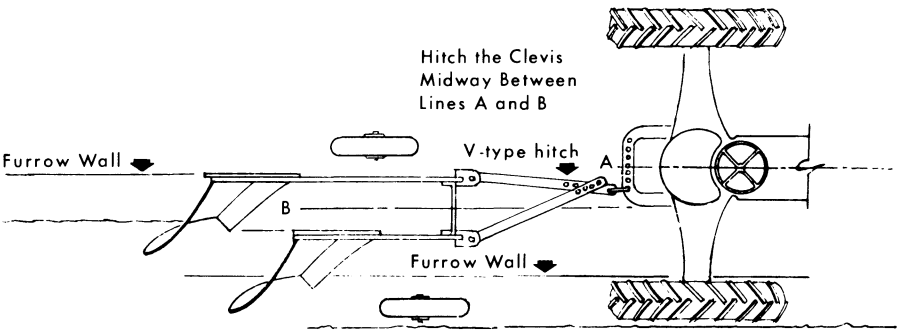

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***Figure 16.*—When a plow is drawn by a wide tractor, the side draft should be divided between plow and tractor by setting the tractor drawbar halfway between center line of tractor and line of draft of plow bottoms, as shown.**

turer of the plow with which it is used. Do not substitute a bolt for a wooden break pin.

Rolling Colter

Setting

Proper setting of the rolling colter depends on field conditions. Ordinarily the blade should cut ½ to 1 inch wider than the share. For plowing less than 6 inches deep, the blade should cut about two-thirds of the depth of plowing; for deeper plowing, it should cut 3 to 4 inches deep.

For plowing soft ground it is customary to set the colter so that there is a clearance of 3 to 10 inches (measured at the soil surface) between the cutting edge and the shin of the bottom. For plowing hard ground it may be necessary to move the colter as far back on the beam as possible and set only deep enough to cut surface debris and produce a smooth furrow wall. With this setting, the cutting edge may just clear the shin of the bottom. This reduces

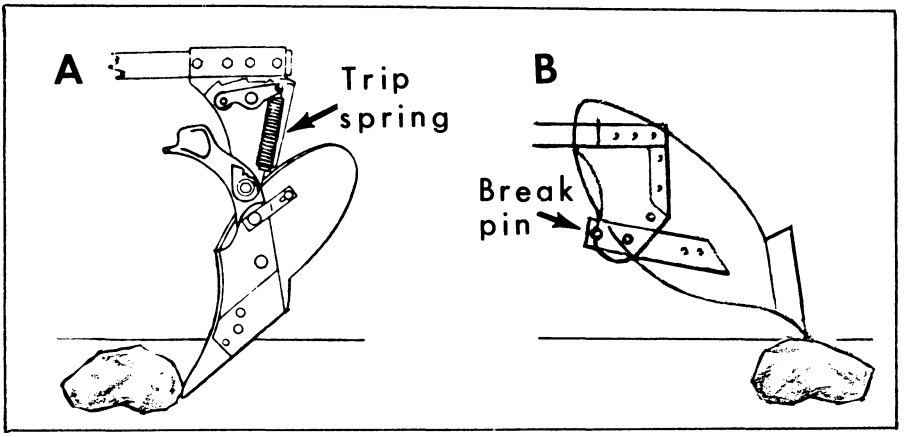

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***Figure 17.*—Two types of hitch releases that are mounted in beams: *A*, Trip-spring release; *B*, break-pin release.**

the tendency of the colter to hold the plow out of the ground.

In stony soil the colter of a light plow is sometimes set ahead and as deep as possible, so that the edge of the colter helps to protect the point of the share, rolling it out and over the stones with less injury to the plow than if the point had stuck.

When colter and plow are working properly, they form a full, straight furrow wall that provides good bearing for the rear wheel or landside. A ragged furrow wall is usually due to narrow or shallow setting of the colter or to incorrect setting of the plow hitch. Since considerable pressure is needed to force the colter into the ground, the hitch should be set a little higher on the front of the beam or lower on the tractor than would be necessary if no colter were used.

Maintenance

Sharpen the colter occasionally by filing or grinding the blade. If you grind the blade, do so carefully; do not draw the temper by overheating.

Keep bearings greased. Keep them adjusted snugly, so that the blade runs true and vertically. Replace bearings that cannot be properly adjusted.

If the shank or yoke is bent, straighten or replace it; or bring the blade into correct position by shims under the colter clamp. A colter that wobbles, leans sideways, or runs at an angle may crowd the plow toward or away from the furrow; if this happens, the plow may not respond to changes in the hitch. Wobbling may also permit trash to wedge between the jointer point and the colter.

Roller bearings maintain proper alinement of the blade with less attention than is required for the plain types of bearings.

Moldboard Jointer

Jointer used with a rolling colter

Arrangements.—A moldboard-type jointer used with a rolling colter may be mounted on an independent shank or on an arm clamped to the colter yoke. The location of the jointer blade, when in operation, is the same on both types of mounting.

Adjusting the Point.—The point should rest lightly against the colter and there should be a V-shaped clearance space starting at the point and increasing toward the top of the jointer. This setting, shown in figure 10, permits bits of trash that may pass between the jointer point and the colter blade to work their way out. In some jointer units the holes in the frog are slotted to allow setting the jointer to give this V-shaped clearance. After the point has worn considerably, or if slots are not provided in the mounting, it may be necessary to grind off the shin above the point to obtain the V-shaped clearance. If the jointer contacts the colter above the point, trash will wedge between the jointer and colter and hinder or stop their operation.

In setting an independent jointer, make certain that it contacts but does not crowd the colter. Crowding interferes with the turning of the colter and may make the plow run unsteadily.

Some types of jointers have inexpensive replaceable points.

Other Adjustments.—When using an independently mounted jointer, set the jointer far enough behind the colter hub to prevent soil and trash from wedging against it. This fore-and-aft relationship is fixed in combination units by the arm holding the jointer. The jointer must be set far enough below the colter hub to allow clearance when using combination colter-jointer units. Small colters—13-inch or less—may not permit setting the jointer properly and obtaining the desired operating depth for the colter.

A moldboard jointer should be set to cut the furrow slice just as the point of the plow starts to lift it (fig. 9, *B*). If it is set too far forward, it will throw soil and trash against the beam of the bottom ahead. If it is set too far back—that is, too close to the shin of the bottom—it will be working in loosened soil, and therefore will not cut a clean furrow or move trash effectively.

Set a jointer low or deep enough to cut a three-cornered ribbon of soil—usually about 2½ inches deep at the point—but not deep enough to completely bury the cutting edge. If the cutting edge is completely buried, the soil slice will not be cut free. The width of the ribbon—usually 3 inches or more—will be determined by the design of the jointer.

Jointer used without a rolling colter

Adjustments for depth of operation and location on the plow beam are the same for a jointer operating alone as for one with a colter. The point should be set to cut ⅜ to ¾ inch wider than the plow.

Failure to scour

If the jointer fails to scour, make certain that it is set to work in relatively firm soil and is polished. Twisting the jointer or tilting it forward or back within the limits of the adjustments provided may help to make it scour. If the jointer still fails to scour, try to get a jointer of a better scouring material—for example, soft-center steel in place of cast iron.

Disk Jointer

A disk jointer should be set with the hub approximately over the point of a bottom equipped with conventional shares. It should be set slightly ahead of the point of a bottom equipped with a simplified share.

If the disk jointer is too far ahead of the shin of the plow, it may tend to hold the plow out of the ground and to throw soil and trash against the beam of the bottom ahead. If it is set too

close to the shin, it will be working in loosened soil and will not turn the soil and trash effectively. It should cut ½ to ¾ inch wider than the plow and 2½ to 4 inches deep.

When the disk jointer is set at the proper angle with reference to the direction of travel, there is a pressure on the furrow wall at the back of the disk approximately equal to the side force caused by the disk. If the angle is too great between the plane of the face of the disk and the furrow wall, there will be no pressure at the back of the disk, and the colter will tend to pull the plow toward the unplowed land. If the angle is too small, there will be excessive pressure at the back of the disk; this will tend to break the furrow wall and to cause the plow to cut narrow.

Covering Wires

If only one covering wire is used per bottom, it is usually fastened to the lower end of the colter shank. This fastening permits the wire to run back over the turning furrow slice with the unattached end under the turned soil (fig. 9). Often it is advantageous to pass the wire through the colter yoke or attach it to different parts of the colter yoke to hold it at the most effective height or location.

Sometimes, especially in loose trash, a second wire is needed to hold debris being missed by the wire attached to the colter shank. It should be attached to some point on the plow frame ahead of the colter shank. It may be attached directly to the frame or to a special bracket. It should be adjusted to hold the trash down nearer to the open furrow than the wire on the colter shank.

Each covering wire should have sufficient tension to hold the trash down and to bend over pieces that would not otherwise be covered. Tension for any plowing condition is controlled by the length of the wire that is under the turned furrow. If the wire is too long, the excess tension may cause trash to be dragged, or may cause trash to be cut in two and thrown onto the plowed soil. If it is too short, it will not hold the trash down.

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***Figure 18.*—Rear wheel of a trailing plow.**

Kinks in the wires will cause them to tangle, drag trash, and—possibly—break.

▶ Attach wires rigidly—that is, clamp or wrap each wire at the attachment point so that flexing comes from bending the wire rather than by movement or pivoting at this point. This tends to hold the wires in the desired locations and reduces the chances of wires dragging under the bottoms when making turns.

Rear Wheel

The rear wheel or rolling landside of a trailing or mounted plow should be set to run in the corner of the furrow behind the rear bottom. It should be set below the landside at a point where it will press against the furrow wall and lead away from it (fig. 18). Manufacturers' recommendations as to clear-

ance under the landside vary according to plow designs; recommended settings range between one-eighth and one-half inch.

The rear wheel of a semimounted plow carries no weight when the plow is in operating position, but carries about 30 percent of the weight of the plow when the plow is raised. On most models it does not carry a side load at any time. However, on some models it locks in position to cause it to take side force when the plow is lowered to its working position. See the manufacturer's instructions.

Leveling Device

In order to plow at a uniform depth it is necessary to set the edge of the front share so that it cuts level with the bottom of the previous furrow. The setting is made with a leveling device, which may be a lever or a screw. If the plow is a trailing type, the device is on the plow frame; if the plow is a mounted or semimounted type, it is on the tractor.

Changing Width of Cut

A lever attachment for changing width of cut while the plow is in operation is available for some plows. The attachment is especially helpful when plowing contoured fields. It can be used to decrease or increase the cut of the front bottom while making turns and thus reduce ridging and poor coverage that result from a too-wide cut.

ROUTINE MAINTENANCE

Rust, the most common cause of scouring trouble, is easily prevented. Oil the plow bottom at the end of each working day. Keep a can of used motor oil on hand for this purpose. Apply the oil with a swab or an old brush.

Misalinement may cause scouring trouble and other difficulties. To prevent misalinement—and to reduce breakage—keep bolts tight.

Lubricate axles, colter bearings, and other moving parts regularly. Check hydraulic fittings and hoses occasionally for leaks and damage.

Store the plow under cover when it is not in use. Clean it and place it on blocks or boards. Do not let bottoms rest on cinders or dirt. If it is to stand 2 weeks or longer, coat the moldboards, shares, colters, and jointers with a heavy grease or a rust-preventive coating. Most oil companies make rust-preventive coatings that are effective for this job.

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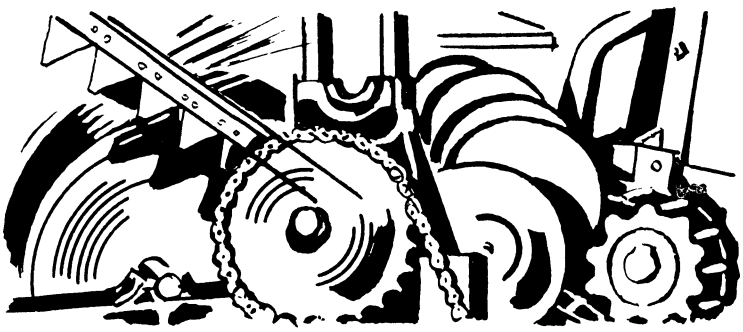

Don't take chances with FARM MACHINES

- Keep guards in place on power shafts, belts, and chains.
- Turn off power and block the machinery before unclogging or adjusting it.
- Don't climb over or around a running combine or thresher.
- Don't step over or under moving belts.
- Don't wear loose-fitting or torn clothing, or ragged gloves arcund moving machinery.
- Keep children away from machinery.
- Keep machinery in good repair.

Farm Machines will save you time . . .

If you use them the safe way